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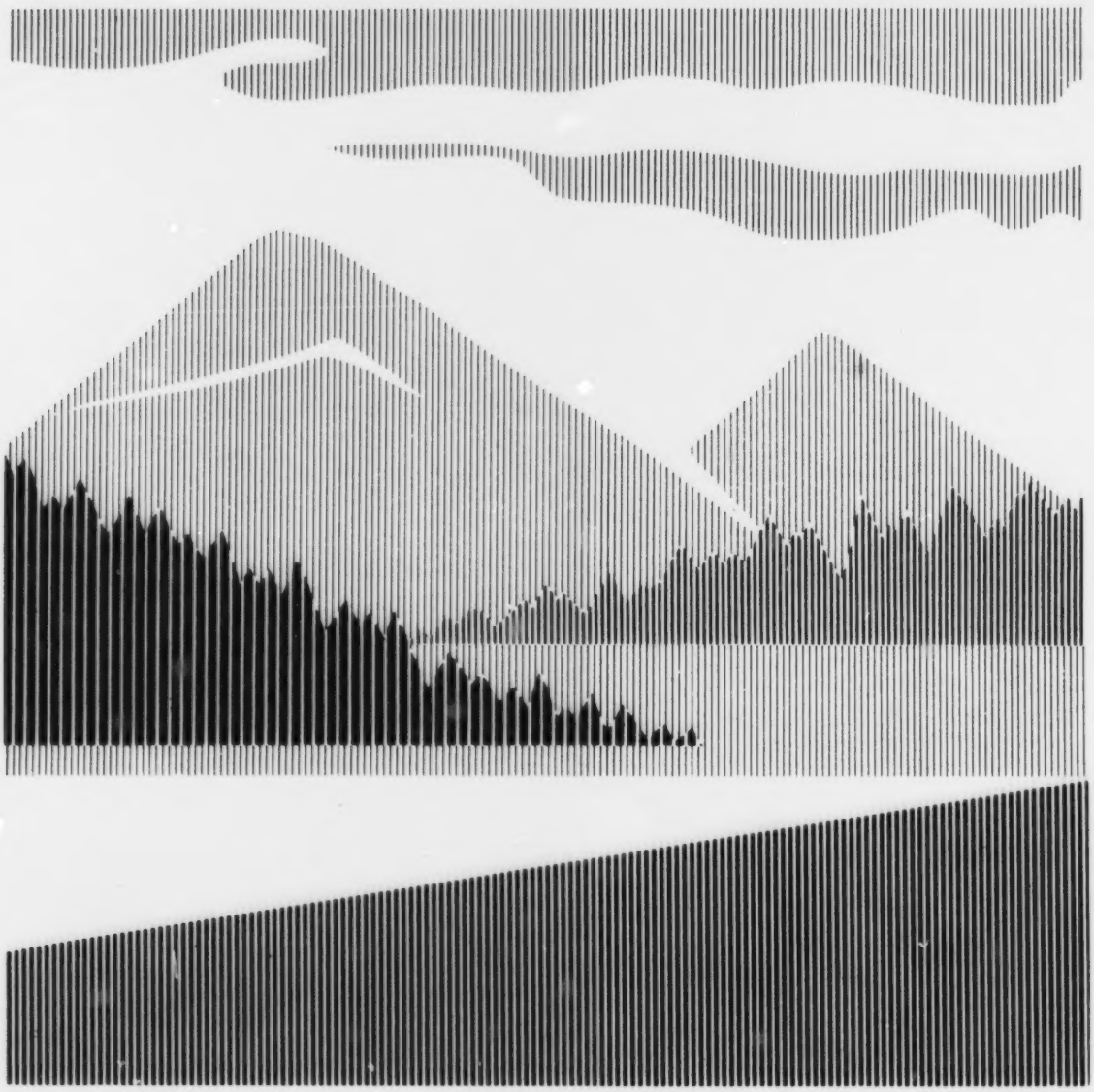
A REVIEW OF NEWFOUNDLAND'S SITE RECLAMATION PROGRAM, 1988

FEBRUARY 1989

by William L. Alexander



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by William L. Alexander

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ABSTRACT

A historical review of Newfoundland's site reclamation program is provided. Candidate treatment areas, treatment options and financial considerations are discussed. The need for a continued site reclamation program is identified and recommendations for future initiatives are made.

RÉSUMÉ

Historique du programme de récupération des terres à Terre-Neuve. Il est question des zones possibles de traitement, des options de traitement et de l'aspect financier. On reconnaît le besoin d'un programme suivi de récupération et on recommande des initiatives pour l'avenir.

TABLE OF CONTENTS

	Page
ABSTRACT	i
LIST OF TABLES	iii
ACKNOWLEDGEMENTS	iv
PREFACE	v
INTRODUCTION	1
HISTORICAL DEVELOPMENT	2
STAND & SITE TYPES	4
Insect killed stands	5
Insect damaged or moribund stands	5
Non-commercial hardwood vegetation	5
High-graded stands	5
Burned timber	5
AREA REQUIREMENTS	5
TREATMENT OPTIONS	7
FINANCIAL AND OPERATIONAL CONSIDERATIONS	12
DISCUSSION	14
CONCLUSION	17
RECOMMENDATIONS	18
REFERENCES	20
APPENDIX A	21

LIST OF TABLES

Page

Table 1. Site reclamation programs funded under federal-provincial cost shared agreements 3

Table 2. List of mechanized site reclamation projects carried out in the province 4

Table 3. Various treatment options vs. favorable stand and site conditions as well as operational constraints 9

Table 4. Comparison of component and total costs up to plantation establishment for various treatment options in reclaiming backlog areas 13

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PREFACE

In the spring of 1987, the co-chairmen of the Silviculture Technical Advisory Committee (STAC) responsible for programs under the Forest Resource Development Agreement (FRDA), appointed a working group to study and recommend strategies for site reclamation (S.R.) programs under FRDA. This group consisted of one member from the Canadian Forestry Service and three members from the Department of Forestry. Terms of reference for the group were established (Appendix A) and a number of meetings and field visits were carried out. As well, a technology transfer visit was made to Northern Ontario.

INTRODUCTION

Site reclamation (S.R.) is a silviculture treatment designed to remove undesirable residual timber and biomass on a backlog forest site by either manual or mechanical means. Cleared areas may then be restocked by natural or artificial regeneration (Alexander and Milne, 1983).

Newfoundland's site reclamation program began in late 1970's with a few small projects scattered throughout the province. The program later expanded to a multi-million dollar program encompassing a wide geographic area. The bulk of all S.R. work carried out to date has utilized labor intensive methods. This approach usually employs traditional cut and bunch harvesting techniques to slash all standing timber on site and salvage any merchantable material available.

Although the manual method is very effective in treating a wide range of stand and site conditions, its major drawback is high costs. These high costs result from salvaging low volumes of commercial wood mixed in the residual stands. Although costs have been reduced approximately 30 percent in recent years through contracting out, costs still average $800/ha. Virtually all sites must then be site prepared (usually slash raking) to prepare the site for planting. This treatment further increases the cost to approximately $1100/ha before the site can be planted. In comparison to similar programs elsewhere in Canada, this cost is high (tramping and burning in Ontario is usually less than $400/ha). Under the present Forest Resource Development Agreement (FRDA), high cost site reclamation has not been given high funding priority. Obviously, treatment of current cutovers will be much more cost effective than treating backlog areas (Alexander and Milne, 1983).

A sobering reality however, is that site reclamation is one of the most required silviculture treatments in this Province. After decades of large

scale extensive management practices combined with recurring insect and disease infestations, many thousands of productive hectares of forest lands on both Crown and Industry limits are in very poor condition. Unless something is done, these sites will be of very little or no commercial value in the foreseeable future. In Forest Management Unit 14 alone approximately 40 000 ha of productive forest land in this condition due to a severe balsam woolly aphid infestation. The spruce budworm and hemlock looper have left large tracks of forest land in all regions void of any merchantable resource. Likewise, historical cutting patterns have left many prime forest sites occupied with low value brush and hardwood species. If Newfoundland intends to maintain and eventually expand its forest industry, these productive forest lands must be brought back into production.

HISTORICAL DEVELOPMENT

The site reclamation program did not gain full momentum until the signing of the first Forest Economic Stimulation Program (FESP) in 1979. The primary mandate of this program focused on job creation as did miscellaneous projects carried out prior to the program. Because of emphasis on job creation, a large portion of the work was carried out via government programs with a predominantly unskilled labor force. This approach resulted in low worker productivity and very high costs per hectare. Costs declined under the two forest subsidiary agreements (FSA's) where much of the work was contracted out. These programs had specified treatment targets (hectares) which placed increased emphasis on costs. Additionally, as government and contractors became more experienced, efficiency improved and costs were reduced. Table 1 identifies outputs and expenditures for site reclamation programs funded under four federal-provincial cost-shared agreements.

Table 1. Site reclamation programs funded under federal-provincial cost shared agreements

Program	Expenditure	Output	$/Hectare
FESP 1 (79-84)	7 565 296	4 916	$1 538.00
FESPII (83-85)	3 856 697	3 703	1 041.00
FSA 1 (74-79)	734 914	1 068	688.00
FSA II (81-86)	2 234 825	2 546	877.00
Totals	$14 391 732	12 233	-

Since the expiry of these agreements, additional programs have funded site reclamation projects. In 1986, $982 414 was spent under a direct delivery Canada Employment Job Development Program to treat 704 ha over seven projects across the province. In 1987 a Provincial Direct Delivery Job Training Program funded 650 ha of projects throughout the province, bringing the total expenditure on site reclamation to date to approximately $16 000 000. This figure represents an average annual expenditure of roughly $1.8 million since 1979.

Mechanical S.R. programs have not gained momentum as a viable alternative to manual methods. Since 1978 an estimated 690 ha have been mechanically treated representing less than 6 percent of the total program. Treatments include 216 ha cleared by a Hydro-Ax rotary chopper, 419 ha cleared by equisyl choppers and approximately 55 ha prepared using a C & H plow (Table 2). Most of these projects were operational trials in that none of the systems were fully developed to an operational level. Indeed, systems such as the Hydro-Ax rotary chopper will never be suitable for site reclamation purposes as site conditions are usually much too severe.

Table 2. Mechanized S.R. Projects carried out in Newfoundland

		1978	1980	1981	1982	1983	1984	Totals
Hydro-Ax	(ha)	60	94	43	29			216
	($/ha)	$510	$638	$935	$1,586			$818
Equisyl	(ha)				231	188		419
	($/ha)				$545	$597		$568
C & H Plow	(ha)				20	20*	15*	55
	($/ha)				$335	$500	$350	$397

* Estimated S.R. area as this represents only part of the total treatment area which included cutover.

STAND AND SITE TYPES

The diversity of stand and site types requiring reclamation is extensive. Areas identified as non-productive for commercial purposes may also contain a multitude of stand and site conditions. These very diverse conditions are the result of natural and human impacts on residual stands over an extended period of time. For example, sites identified for site clearing often contain patches of sub-merchantable standing wood along with areas of blowdown and patches of healthy and poor regeneration. This incredible mixture makes these areas difficult and expensive to treat.

For the purpose of this report, sites are broken down into five categories. The common feature of these stands is that they are not merchantable by current harvesting standards. Although most sites contain a percentage of salvageable fiber (<60m^3/ha), these low volumes are usually very expensive to extract.

1. Insect killed stands: site usually occupied by large volumes of dead balsam fir mixed with a smaller component of white birch. Most stands naturally regenerated after harvesting from 1930 to 1960 and contain varying amounts of natural regeneration. Usually occupy the better forest sites in the central and western regions.
2. Insect damaged or moribund stands: sites occupied by large volumes of dead and diseased wood due to repeated insect attack. The single largest treatment area is in Management Unit 14 where approximately 40 000 ha of balsam fir cover type is in a moribund state due to repeated balsam woolly aphid infestation.
3. Non-commercial hardwood vegetation: sites occupied by poor quality birch, aspen, pin cherry, mountain ash, mountain maple, etc. on the most productive forest sites in all regions. Present condition a result of clearcutting or wildfire.
4. High-graded stands: sites occupied by poor quality residual hardwood and softwood species remaining after selective harvesting. These stands occur on both good and poor sites after sawlog harvesting or in close proximity to communities where domestic cutting pressures are high.
5. Burned timber: sites primarily occupied by standing burned timber. The component of green vegetation increases with age of burnover and site capability. Most sites are found in the central region.

AREA REQUIREMENTS

Of primary importance in developing any program is the need to identify particular treatment requirements. In addressing the need for treatment of backlog areas through site reclamation programs, knowledge of the total area of candidate sites is required. This information would enable managers to plan a treatment strategy based upon need and available funding.

Accurate figures that clearly identify backlog areas available for treatment are difficult to derive for a number of reasons:

1) current inventory does not have the capability to identify all the stand types considered to be in a commercially non-productive state (i.e., aphid damaged stands);

2) accessibility of candidate sites is uncertain;

3) due to persistent insect and disease problems, the total area available for treatment is continually changing.

Although precise figures are unknown, it is generally felt by the forestry community that the total area of productive forest land in a commercially non-productive state is substantial. Regeneration surveys carried out by both Forestry Canada and DF estimate that approximately 10 percent of all cutovers do not regenerate adequately. If this figure is combined with the sixty year history of extensive pulpwood harvesting prior to the advent of present silviculture programs, this alone suggests that there could be as much as 50 000 ha of cutover backlog. Additionally, the long history of insect and disease infestation and wildfire has greatly added to the problem. Since the early 1960's an annual average of 700 ha of productive land has been burned over, combined with greater than 400 000 ha killed in the recent spruce budworm and hemlock looper outbreaks.

Workable estimates of backlog on productive lands can be derived, despite the obstacles identified. Well defined criteria must be established to identify backlog area. Also, a coordinated effort between the forest management division (inventory section) and the regional forestry divisions would have to be implemented. The forest management unit system might best be used as a basis for determining area requirements due to unique circumstances in certain units and the familiarity of the forest land base by unit staff. Such an exercise would be a valuable asset toward planning a comprehensive site rehabilitation program for the province.

TREATMENT OPTIONS

Depending on stand and site conditions, a number of treatment options are available to reclaim backlog areas. Certain treatments are best suited to particular stand and site conditions, and are restricted in the amount of area they can effectively treat. This fact is particularly true for treatments utilizing heavy equipment such as crawler tractors and drum choppers. Nonetheless, this equipment can be quite effective in terms of operability and costs if applied to the right site.

The most versatile option in terms of treating a wide array of stand and site conditions is the labor intensive manual option. This system has predominated site clearing efforts in Newfoundland primarily due to very favorable job creation aspects of the program. The major drawback is high costs which are often double those of certain mechanical methods. However, this situation can be improved through a) increased planning, b) incentives to private wood contractors and fuelwood cutters to promote good forest management practices, and c) improved utilization. These incentives are discussed later.

Although in many instances the manual option is the best option, in certain cases other treatment types may be more cost effective. For example, in recent years one project in Unit 07 manually felled 2-4 meter juvenile fir stands that had been killed by budworm. The average cost was approximately $750/ha. Although the area was eventually burnt in a 1986 wildfire, the original intent was to site prepare the area before planting. This treatment would have cost an additional $200-300/ha bringing the overall cost to approximately $1,000/ha before the area was suitable for planting. Meanwhile, just a short distance away, a C & H plow was used to reclaim a similar area and produced a site suitable for planting at an approximate cost of $350/ha or

roughly 1/3 that of the manual system. Although this project was very small, the point can be made that if the mandate is to effectively reclaim backlog at the least cost, various treatment options may be available.

Improved planning and the flexibility to utilize various treatment options (manual or mechanical) will help lower costs and ultimately reflect an expanded program. Table 3 lists those treatment options that could be used to treat backlog areas in this province. They will be discussed in greater detail later.

Most of the treatment options identified, except for numbers 4 and 5, have been tested to some extent in Newfoundland. Most of these, except for manual clearing have run into difficulty for a number of reasons. For example, mechanical crushing with drum choppers was used on moribund stands of juvenile balsam fir in Management Unit 14. The original intent was that this treatment alone would produce good planting sites without the need for additional site preparation treatments. This assumption would have been correct if most of the standing material had been dead. In actual fact, most material, although severely defoliated, was green and had the tendency to remain intact and partially spring back after being run over by the choppers. This problem created the need for follow-up treatments including prescribed burning in one area and slash raking in another. Although these follow-up treatments worked well, the overall cost to reforest the sites increased by approximately $200/ha.

Similarly, the C & H Plow had difficulty in treating both standing insect killed and standing burned timber where residual volumes on site were high. In areas where volumes were low, fewer problems were encountered. Other potential treatments such as herbiciding and burning, although practiced in other provinces such as Ontario, have not been trialed in this province. The

Table 3. Various treatment options vs. favorable stand and site conditions as well as operational constraints.

Treatment Type	Stand & Site Conditions	Constraints
1) Manual cut & pile	- All sites - Best suited to sites with significant salvage	Very expensive and often require expensive S.P. treatment to ameliorate heavy slash loadings before planting.
2) Mechanical crushing	- 0-10% slopes - light to moderate dead standing timber - good ground bearing capacity	- green vegetation - steep or rocky terrain - vet ground
3) C & H Plov	- standing burned timber - light dead standing timber - 0-10% slopes - even terrain	- excessive standing timber - vet, steep or rocky ground - broken terrain
4) Chemical browning & crushing/burning	- backlog vegetation areas after harvesting or vildfire	- requires very good ground if folloved up by crushing, hov-ever, can be applied to very rough ground if folloved up by broadcast burning * - prescribed burning not operational
5) Tramping (or slashing) & Burning	- best suited to sites with very lov merchantable volumes	- restricted to areas with little or no hardwood vegetation - areas must be suited to broadcast burning operations * - prescribed burning not operational
6) Commercial biomass voodchip harvesting (fuel)	- vide variety - good volumes of sal-vageable voodchip fuel	- lack of markets - lov volume, small diameter stands that are difficult to harvest
7) Domestic voodfuel	- vide variety - must contain good voodfuel	- must be close to high demand areas - availability of voodfuel resource must be limited - difficult to control (monitoring)

* This constraint may be reduced in coming years.

major reason for this situation is that both options require follow-up broadcast burning which is not yet operational in Newfoundland.

Of all the potential options identified for clearing backlog areas in preparation for reforestation, one of the most attractive has to be whole tree harvesting for biomass woodfuel. Although most commercial biomass chipping operations to date have concentrated on the energy aspects of such programs, the potential silviculture benefits of an expanded program are substantial. For example, in Nova Scotia, Stora Forest Industries annually clear in excess of 1200 ha through their biomass woodfuel program. In future, efforts must be made to steer commercial biomass operations in Newfoundland toward areas that exhibit the greatest potential for silviculture benefits. This strategy may require incentives to have low volume areas cleared, but this practice may be justified to encourage new operations. It is important to note, however, that volumes may be too low in certain areas to make biomass harvesting economically viable. In other provinces biomass operations have utilized slash on cutovers for fuel where total volumes approximate 50 tonnes/ha. Most residual stands in Newfoundland will contain greater volumes of residue. The economic viability of harvesting a particular site depends on volumes on site, the harvesting system and the equipment being used.

The biggest deterrent to expansion of the wood energy industry is the capital cost of woodfuel burning systems. Nevertheless, this cost should be put into some perspective relative to the annual cost of manual site reclamation programs. Since 1980, S.R. programs, including raking in Unit 14, have treated approximately 500 ha annually at average costs of roughly $1,000/ha. This figure represents annual expenditures of $500,000 on the program in that Unit.

Since the early 1980's, the Abitibi-Price newsprint mill in Stephenville has been identified as having good potential to burn approximately 60 000 tonnes of biomass woodfuel per year without significant capital investment (approximately $250,000 for a woodchip infeed system into an existing boiler). This cost represents one-half (1/2) of the annual site reclamation expenditure in the Unit and would ultimately result in the annual clearing of 400 ha if average biomass volumes approximated 150 tonnes/ha. Such a program would create an annual requirement for 1 000 000 seedlings. Lower volumes per hectare (<150 tonnes/ha) would ultimately result in larger areas being cleared since demand would remain constant and more hectares would have to be cut to acquire necessary fuel supplies. This simplistic calculation demonstrates the real potential for commercial woodfuel operations and offers a partial solution to the single biggest obstacle facing site reclamation programs - what to do with the large volumes of unusable fiber on most sites. Even if a small subsidy was required to encourage operators into low volume sites, this approach would still be cheaper than manual cut and bunch operations that usually have no markets for the bulk of biomass fiber on site.

Because most sites contain large volumes of biomass suitable only for fuel, in certain high demand areas (e.g., Avalon Peninsula) domestic fuelwood cutters could be directed into designated site reclamation areas. Through various operational and financial incentives, domestic cutters could be encouraged to clear areas to the same standards required for commercial operators. This type of program has been tried in Unit 02 and Unit 17 with varying degrees of success, however, such a system will only work in high demand areas where the available resource is scarce or poorly accessed. Such a program will not clear large areas in a short time as in commercial operations. However, if properly

managed over time, domestic programs should result in significant areas being cleared at very low costs. Commercial woodfuel operators might also be encouraged to operate in similar areas.

In Ontario, commercial wood contractors operating in semi-merchantable areas are given financial incentives to clearfell pockets of non-merchantable stands within the confines of large operating areas. The Ontario Ministry realizes that the original operator can carry out the required work more cheaply than a second operator sent in after the first operator has moved out. This practice should be considered in Newfoundland as the same type of problem is quite common in insect damaged and uneven aged stands.

FINANCIAL AND OPERATIONAL CONSIDERATIONS

To fully appreciate the real cost of reforesting backlog areas, all treatment requirements and the associated costs must be identified (Table 4). Most cost information is based on operational experiences in Newfoundland. Where data were not available, information from other provinces is used.

Despite approximate costs, Table 4 can be used to make the following general observations:

1) **regardless of the treatments used, reforestation of backlog areas is very expensive;**

2) **manual site reclamation programs are the most expensive; and**

3) **mechanized treatments will be the most cost effective, especially those treatments that can be utilized without the need for additional follow-up treatments or those that can use broadcast burning.**

Although the need for long term site rehabilitation work is recognized, cost reduction on site reclamation programs must receive top priority. Given the fact that clearing backlog areas can cost twice as much as planting

Table 4. Comparison of approximate component and total costs up to plantation establishment for various treatment options in reclaiming backlog areas.

Treatments	Treatment Costs for Various Options ($/Hectare)							
	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Manual cut & pile	800.00							
Manual slashing		600.00						
Drum choppers			550.00					
Tramping (Tractor only)*				350.00	350.00			
Mechanical felling (Cantera)**							325.00	
Biomass harvesting								0.0
Slash raking	300.00	300.00					300.00	
Windrow burning	25.00	25.00					25.00	
Broadcast burning			180.00		180.00			
C & H Plow				325.00		325.00		
Seedling Production***	450.00	450.00	450.00	450.00	450.00	450.00	450.00	450.00
Planting	450.00	450.00	450.00	450.00	450.00	450.00	450.00	450.00
Total Cost/Option	$2,025.00	$1,825.00	$1,630.00	$1,575.00	$1,430.00	$1,225.00	$1,550.00	$900.00

* Figures based on Ontario experiences with 20% increase for Newfoundland conditions

** Very preliminary figures based upon conversation with Mark Ryans (F.E.R.I.C.).

*** 2,500 trees/ha @ $.18/tree

and three times that of most site preparation treatments, even moderate savings in site reclamation costs will impact significantly on the total output of the silviculture program.

The probability of further reducing manual (labor intensive) operational costs is low, since costs have been reduced by approximately 33 percent in recent years through contracting out. It is certain that annual inflation will always be a factor. Additional savings may be achieved through the use of multi-phase contracts (i.e., manual felling + slash raking + windrow burning), however, it is unlikely that this will result in greater than a ten percent cost reduction.

In the past, some S.R. programs have been charged royalty on salvaged wood despite the fact that the areas being treated were not commercially harvestable (volumes <60 m^3/ha). Adding royalties simply increases the total

program cost since the contractor will have to compensate for this increased expense. This practice is a deterrent to lowering costs and should be discouraged.

The greatest economic gains will likely be achieved through increased mechanization, however, the development of a complementary prescribed burning program must also occur. Treatments such as tramping with crawler tractors and crushing with drum choppers tend to flatten rather than shear residual timber. Consequently, follow-up treatments like slash raking will not be effective, making broadcast burning the only possible option. If new systems are developed and prove satisfactory (e.g. Cantera), then adequate follow up may be achieved through slash raking or heavy scarification using the C & H plow. As stated previously, the large volumes of unusable biomass on most sites makes reforestation efforts on backlog areas difficult. The problem is not manually crushing standing residual timber, but rather what do you do next?

DISCUSSION

Present efforts to reforest the extensive backlog forest areas must continue. These sites are often very productive and may be occupied by low value forests. Many backlog areas lie within close proximity to the existing forest industry and in their present condition will be of little commercial viability for many years. Reforesting these sites will help address concerns over future industrial wood supplies and may eventually result in expanded AAC capability, and an expanded industry.

Although past and present site reclamation efforts have been quite successful in clearing areas and creating jobs, the program has been very expensive. Attempts must continue to improve the existing program through cost cutting measures such as multi-phase contracts, woods contractor incentives, etc. Given Newfoundland's high unemployment, labor intensive programs geared

toward job creation will likely continue for some years to come. Consequently, manual S.R. programs should be directed to the most suitable sites. These include ecologically sensitive areas, areas in close proximity to communities, areas requiring wood salvage, and difficult terrain where mechanical treatments are not possible. Manual treatments may be the only socially acceptable treatment in close proximity to many communities due to the unsightly and non-aesthetic appearance of mechanical operations.

Efforts must be made to develop new more cost-effective systems through increased mechanization. This work should be carried out under the auspices of the Canada-Newfoundland Forest Resource Development Agreement (FRDA) since a mandate of FRDA's is to promote technology transfer and the development of cost effective programs. Specifically, trials should be established to test systems developed elsewhere to determine the operability and associated costs of these systems under Newfoundland conditions. Organizations such as the "Prime Site Group" of the Ontario Ministry of Natural Resources have been working on backlog problems for a number of years. The Ontario Ministry has extensive experience in rehabilitating backlog areas and much can be learned from their experiences.

The Forest Engineering Research Institute of Canada (FERIC) is now studying the site reclamation problem in Canada in an attempt to aid client agencies develop newer and more cost-effective methods for clearing residual stands. FERIC is presently proposing to purchase a machine specially designed for clearing junk stands (CANTERA) and to further improve the machine for pre-commercial thinning and residual stand clearing. One interesting feature of the Cantera machine is that after treatment, managers should be able to prescribe slash raking, broadcast burning or the C & H plow as follow-up treatments. This flexibility is not prevalent in most other mechanical treatment options.

The development of a large operational prescribed burning program must receive top priority. Progress in prescribed burning in Newfoundland since 1984 has been very slow. This situation must be improved if the province is to increase its S.R. program, and at the same time reduce costs. The most obvious feature of Ontario's S.R. program was the province's ability to prescribe burn virtually every hectare of backlog area treated. Ontario's program relies heavily on prescribed burning. A direct benefit is reforestation costs that average $750/ha, roughly 50 percent of Newfoundland's costs. The Ontario approach usually entails mechanical tramping ($300/ha), prescribed burning ($50/ha) and planting ($400/ha). Ontario's prescribed fire program has played a major role in reducing site reclamation costs. Newfoundland should continue its technology transfer program with Ontario and perhaps consider the possibility of acquiring an experienced prescribed burning expert from Ontario to aid expedient development of Newfoundland's program.

The Department of Forestry should accurately identify backlog reforestation requirements in the province. This task should encompass all productive forest lands, especially since 60 percent are occupied by the forest industry. The forest industry should be encouraged to become actively involved in rehabilitating productive lands on their limits, especially in close proximity to the mills. This practice has not happened in the past. Also, efforts should be made to access the extent of the backlog problem on alienated industry lands that are of low priority to industry. This would enable planners to identify specific treatment targets aimed at eventually treating all available backlog. At the same time, every effort must be made to discourage harvesting practices that create additional or more difficult backlog requirements. In the past, some Units have permitted commercial operators to harvest all salvageable material in marginal operating areas and then follow up with site reclamation treatments. These areas are more difficult and expensive to treat in this way

since the original operation only serves to make a bigger mess and create a more difficult problem. A better approach would be to provide incentives for the original operator to carry out all clearing work at the same time as the salvage of all merchantable wood on site. This practice is common in Ontario.

With regards to the biological aspects of site reclamation programs, there is room for improved planning. To date, limited consideration has been given to the effects of exposure on newly established plantations. This is particularly important in coastal regions where most of the Crown program is concentrated. Site reclamation projects are often very large (> 150 ha) and at times tend to run into one another creating extremely large cutovers. Potential problems may result from extreme wind and salt exposure in many coastal regions, and the fact that many areas are planted to black spruce, which is not tolerant of severe exposure. Future programs should consider exposure factors and where necessary modify cutblock size (< 100 ha) and shape, and plant only the most hardy species such as white spruce.

CONCLUSION

A major portion of the Crown planting program is dependent on site reclamation to provide suitable planting area on Crown lands. In 1987, 54 percent of all Crown land planting was implemented on S.R. cutovers. In all likelihood, nursery production and subsequently the annual planting program will have to be cut back in the absence of an S.R. program.

Vast areas of productive forest land devastated by fire, insect and disease and extensive management practices must be regenerated. This requirement, however, should be weighed against the need to practice cost effective silviculture. Projected wood supply deficits dictate that programs attempt to produce maximum returns in as short a time frame as possible for least cost. Clearly, site reclamation does not score well considering its high cost and long investment period before plantations can be harvested. Emphasis must be placed

on mechanical vs. manual options for site clearing. Environmental, social and economic factors must be considered when planning programs. The challenge to reforest backlog forest lands in Newfoundland will only be met through a coordinated effort by government and industry and the development of a strategy that is all encompassing in its approach to the problem.

RECOMMENDATIONS

Based upon the findings of the site reclamation committee, the following recommendations are made:

1) The existing program of reforesting backlog areas in this province be continued.
2) Concerted efforts should be made to determine the total backlog requirements in the province irrespective of tenure.
3) Major emphasis must be placed on site productivity with highest priority on treating the most productive sites in close proximity to the existing forest industry.
4) Increased emphasis should be placed on industry held lands, especially licensed lands since these tenures often occupy some of the most productive forest sites. This situation is especially relevant in Forest Management Units where the potential for backlog rehabilitation is high and the availability of unalienated Crown land is limited.
5) A well-planned program for both industry held and Crown lands should be developed with the goal of eventually treating all available backlog. This program plan would be developed and coordinated by the Provincial Department of Forestry and would identify annual treatment targets based upon need.
6) Priorities should be established to direct the various funding programs to those sites best suited to the particular mandates of those programs. For example, since FRDA funding is limited, the program requires that major

emphasis be placed on the most cost-effective methods. Job creation funding should be directed to sites that are more ecologically and aesthetically sensitive, have higher salvage volumes and do not place major emphasis on productive costs.

7) Financial incentives must be established to discourage further creation of man-caused backlog in semi-commercial operating areas where residual non-commercial volumes are high. This practice is common in Ontario.

8) Extensive trials should be established by DF beginning in 1989 to test various mechanical and manual options that may have potential. Technologies developed outside the province and seen as having potential here should be tested. These trials should be well planned and documented in that information gained will serve to direct future initiatives under the site reclamation program.

9) Every effort must be made to encourage development of commercial fuelwood markets. Where possible, biomass woodfuel operations should be directed to the most productive backlog sites containing high volumes of otherwise unusable residue. Department personnel from forest products, silviculture and research, and regional services should form a small committee to ensure that the site rehabilitation program capitalizes on this opportunity.

10) The expedient development of an operational prescribed burning program is essential to development of certain mechanical site reclamation systems (i.e., tramping and burning).

11) Increased emphasis should be placed on the biological aspects of the program, especially relating to the impact of coastal environments on newly established plantations. Potential policies could include limiting cutblock size and planting wind-hardy species.

REFERENCES

Milne, G.R. and W.L. Alexander. 1983. Stand reclamation in Newfoundland, issues and alternatives. Paper prepared for Silviculture Newfoundland Symposium, Grand Falls, Nfld. April 5-6, 1983.

APPENDIX A

SITE RECLAMATION COMMITTEE
(TERMS OF REFERENCE)

MEMBERSHIP: One representative of Forestry Canada. Three representatives of the Department of forestry representing eastern, central and western regions.

CHAIRMAN: Bill Alexander, Forestry Canada

RESPONSIBILITIES:

1) To consolidate pertinent information from all previous site reclamation programs carried out in this province.

2) To identify the various stand and site types that require site reclamation treatments with particular emphasis on areas that will not regenerate naturally.

3) To identify the potential for future site reclamation work in traditional as well as non-traditional areas with major emphasis on supporting the existing forest industry.

4) To investigate the various systems (manual and mechanical), both within the province and outside, suited to perform the required treatment.

5) To investigate alternative incentive programs that may have merit (i.e., domestic stand recs, negative stumpage, mini licenses, etc.).

6) To study the cost effectiveness of the various systems identified.

7) To produce a report to STAC recommending a long term strategy for site reclamation in the province.